OC4213 – NEARSHORE AND WAVE PROCESSES

LAB #1 – Tide/Surge/Swell Observations

January 19, 2012

I. INTRODUCTION/BACKGROUND

In this week's lab students will be examining some single point pressure sensor data from three different nearshore regimes. These data were collected as part of separate experiments: **DUCK94** in the Atlantic Ocean off the North Carolina coast, **SAX04** in the Gulf of Mexico off the Florida panhandle, and **NCEX** in the Pacific Ocean near San Diego. The general station locations for the data of this lab are shown in Figs. 1-3.

Pressure time series data can provide us with important information concerning the nearshore environment. Shorter duration timeseries (30 minutes – 3 hours) collected at 1 or 2 hz can be used to gather information about the swell and sea conditions, while longer records (weeks-months) of sea level (averaged over several minutes to take out the wave excursions) provides information about tides and storm surges. The purpose of this lab is to observe the differences between nearshore wave and tide conditions on three different coasts. This lab will also serve to re-familiarize the students with some of the basic techniques used to examine timeseries data.

II. DATA

The data were collected in self-contained pressure sensors mounted on the bottom sampling at a rate of 2 Hertz. For DUCK94 the pressure sensor was deployed in approximately 6m water depth while in the NCEX and SAX04 experiments the deployments were made in approximately 10-11m water depth. For each of the three different sites there is a single ascii file containing 10 minute averaged data. Each record of a file contains the date/time and average pressure during the 10 minute averaging interval. The record structure is as follows:

- Field 1 – Year
- Field 2 – Month
- Field 3 – Day
- Field 4 – Hour
- Field 5 – Decimal minutes
- Field 6 – Pressure (averaged) in cm.

These files are named: **duck94ave.dat, ncexave.dat, and sax04ave.dat.**

Additionally, there are files containing the basic wave parameters (significant wave height (H_S) and dominant wave period (T_P)) calculated from three hour sections of the raw 2 hz time series at each location.

The files containing the wave statistics are named: **duck94_stats.dat, ncex_stats.dat,** and**, sax04_stats.dat**. Each line in the file contains the date/time information and wave conditions during a three hour time interval. The format for this data is:

Field 1 – Year
Field 2 – Month
Field 3 – Day
Field 4 – Hour
Field 5 – Minutes
Field 6 – Significant Wave Height (m)
Field 7 – Dominant Wave Period (sec)

The data for each pressure sensor can be accessed through the course web site: www.oc.nps.navy.mil/wavelab/courses/oc4213. Follow the links to "Labs" and then "Lab1 Data".

III. LAB TASKS/PROCEDURES

Each student is responsible for producing the following for this lab:
For **each** of the three sites:

1) Create plots of the 10 minute mean pressure data vs. time. Can you find any obvious storm surges (i.e. sea-level rise or drop during a storm)? If so, describe them in terms of magnitude and duration.

To better see the tidal characteristics, also create a plot of one week of this data. Describe the difference between the sites in terms of tidal range and diurnal or semi-diurnal characteristics.

2) Calculate the bottom pressure frequency spectrum for the 10 minute averaged data. Identify the main tidal peak ort peaks and their frequencies.

3) Create plots of significant wave height vs. time and dominant wave period vs. time for each of the three locations for the entire length of the data set. Describe the differences between the three regimes in terms of the observed wave characteristics. Do you note any correlation between energetic wave conditions and the sea level time series created in step 1? If so, explain.

SPECIFIC PROCEDURES

The specific procedures needed to accomplish these tasks can be broken down as follows:

1) Copy the appropriate time series and wave statistics data into your working directory.

2) Copy the m-files **load_pdat.m** from the web site to your working directory.

3) Load the time series data file into the matlab environment using the m-file "load_pdat". To load the data use the command **[tme,prs]=load_pdat;.** The function will prompt the user for the name of the data file and return the time (**tme**) and pressure (**prs**).

4) The plots for the averaged data can be created using matlab's plot command. To set the time axis for one week use the command :

set(gca,'xlim',[tme(1) tme(1)+7]) after you have completed the first plot.

5) To calculate the bottom pressure spectrum use the command:
[bps,f]=psd(prs,npts,sr,'mean'). returns the bottom pressure spectrum **(bps)** (units in m^2/cycle/hr) and the frequencies at which the spectrum is estimated **(f)** (units in cycles/hour) given the raw bottom pressure time series **(prs)**, the number of points per segment **(npts)**, and the sampling rate **(sr)**. The extra parameter 'mean' indicates that the segment is to be detrended by removing the mean before performing the spectral calculations**. To resolve the tidal frequencies of the energy peaks use 512 points/segment. Also use a sampling rate of 6 (units are cycles/hr) corresponding to the 10 minute sampling interval.**

6) Plot the bottom pressure spectra on a semilogy plot.

7) To create the plots of the significant wave height and dominant wave period first load these data into matlab. This can also be done using the load_pdat function. Use the command **[tme,hs,tp]=load_pdat;.** The function will prompt the user for the name of the wave statistics file and return the time (**tme**), significant wave height (**hs**), and the peak period (**tp**).

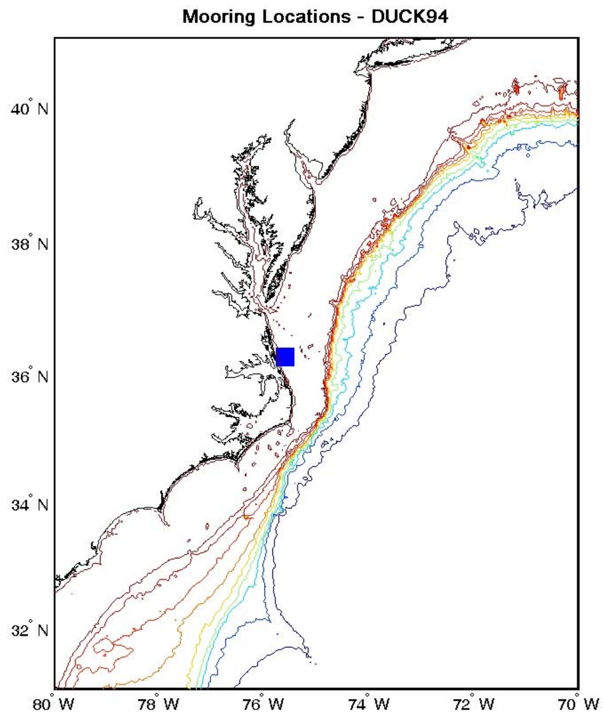

Figure 1 – Location and bathymetry for DUCK94 pressure sensor.

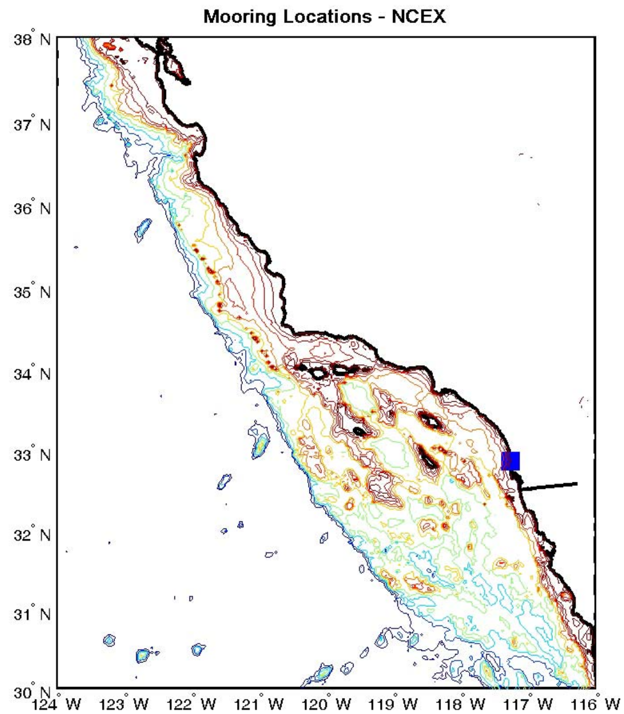

Figure 2 – Specific location and bathymetry for NCEX pressure sensor.

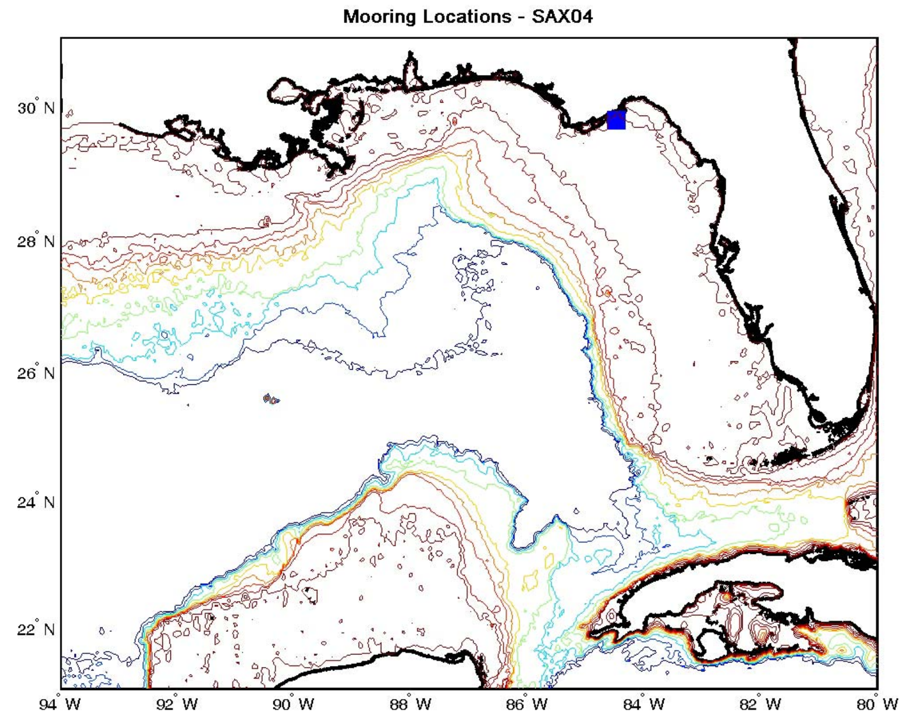

Figure 3 – Location and bathymetry for SAX04 pressure sensor